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(54) NONMAGNETIC SPRING MATERIAL AND METHOD FOR ITS
PRODUCTION

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Specification

1. Title of the Invention

NONMAGNETIC SPRING MATERIAL AND METHOD FOR ITS PRODUCTION

2. Scope of Patent Claim

1. A nonmagnetic spring material having high spring performance, which contains, by weight percent, 5 – 35% manganese, 5 – 35% nickel, and a total of 0.001 – 20% of any one or two or more elements included in the following group 1 elements and/or group 2 elements, with the remainder being essentially copper.

(List)

Group 1 elements

Aluminum, silicon, titanium, vanadium, chromium, iron, cobalt, germanium, arsenic, zinc, tin, zirconium, niobium, molybdenum, hafnium, tantalum, tungsten

Furthermore, the total content of elements of group 1 elements is within a range of 0.01 – 15%.

Group 2 elements

Carbon, nitrogen, magnesium, beryllium, phosphorus, sulfur, calcium, potassium, selenium, yttrium, rare-earth elements, silver, indium, tellurium, lead

Furthermore, the total content of elements of group 2 elements is within a range of 0.001 – 5%.

2. The nonmagnetic spring material in claim 1, further characterized in that the spring critical value is 100 kg/mm^2 and the permanent set to displacement by the spring critical value or a higher value is low.

3. The nonmagnetic spring material in claim 1, further characterized in that the spring material is used in magnetic heads.

4. A method for producing a nonmagnetic spring material having high spring performance, characterized in that an alloy that contains, by weight percent, 5 – 35% manganese, 5 – 35% nickel, and a total of 0.001 – 20% of any one or two or more elements included in the group 1 elements and/or group 2 elements, with the remainder being essentially copper, is solution-annealed, then cold-drawn, and further aged.

Group 1 elements

Aluminum, silicon, titanium, vanadium, chromium, iron, cobalt, germanium, arsenic, zinc, tin, zirconium, niobium, molybdenum, hafnium, tantalum, tungsten

Furthermore, the total content of elements of group 1 elements is within a range of 0.01 – 15%.

Group 2 elements

Carbon, nitrogen, magnesium, beryllium, phosphorus, sulfur, calcium, potassium, selenium, yttrium, rare-earth elements, silver, indium, tellurium, lead

Furthermore, the total content of elements of group 2 elements is within a range of 0.001 – 5%.

5. The method for producing a nonmagnetic spring material in claim 4, further characterized in that solution annealing is performed at 700°C – 1,000°C.

6. The method for producing a nonmagnetic spring material in claim 4, further characterized in that cold drawing is performed at a draft of 10% or more.

7. The method for producing a nonmagnetic spring material in claim 4, further characterized in that aging is performed at 350 – 500°C.

3. Detailed Description of the Invention

[Technical Field of the Invention]

The present invention pertains to a spring material that is nonmagnetic and has excellent spring performance, and a method for its production.

[Prior Art and Problems]

There is a demand for high-strength springs that are repeatedly nonmagnetic in the presence of a magnetic field and have excellent spring performance, [and these are used] starting with magnetic recording-related equipment. For instance, during the process of casing magnetic heads in the production of magnetic heads, magnetic-head push spring (2) is used in order to anchor a magnetic head consisting of core (1), coil (3), terminal (5), resin part (6),

core holder (7), etc., to shield case (4) and to maintain dimensional accuracy, as shown in Figure 1. Phosphor bronze and beryllium copper have been used in these magnetic-head push springs, but recently production technology has become more difficult as a result of the development of high-performance magnetic heads. There is a demand for high spring performance in order to obtain better dimensional accuracy with these magnetic-head push springs. From this standpoint, there is a need for improvement, because, although it can be said that beryllium copper is a good material, beryllium vapor and beryllium oxides, etc., which are toxic to humans, are generated during this production process and also, this production process is complex.

Moreover, although Ni-Si-Cu alloys and Ti-Cu alloys have recently been developed as alloys having the same high spring performance as beryllium copper, these alloys are not sufficient.

[Object of the Invention]

The present invention is in light of the above-mentioned problems, its object being to present a nonmagnetic spring material with the same or better spring performance as beryllium copper and a method for producing the same.

[Summary of the Invention]

The present inventors were the first to discover that the same high spring performance as with beryllium copper is obtained by solution annealing an alloy that contains, by weight percent, 5 – 35% manganese, 5 – 35% nickel, and a total of 0.001 – 20% of any one or two or more elements included in the group 1

elements and/or the group 2 elements, with the remainder being essentially copper, then cold drawing, and further aging.

Group 1 elements

Aluminum, silicon, titanium, vanadium, chromium, iron, cobalt, germanium, arsenic, zinc, tin, zirconium, niobium, molybdenum, hafnium, tantalum, tungsten

Furthermore, the total content of elements of group 1 elements is within a range of 0.01 – 15%.

Group 2 elements

Carbon, nitrogen, magnesium, beryllium, phosphorus, sulfur, calcium, potassium, selenium, yttrium, rare-earth elements, silver, indium, tellurium, lead

Furthermore, the total content of elements of group 2 elements is within a range of 0.001 – 5%.

That is, in the past it was possible to evaluate spring performance based on the spring critical value (or tensile strength) alone, but the inventors of the present invention were the first to discover that in addition to the spring critical value, the permanent set to stress that exceeds the spring critical value is important to spring performance and that high spring performance is only realized by obtaining both of these properties (the spring critical value and the permanent set to displacement by the spring critical value or higher). For instance, judging from studies of Cu-Ni-Sn alloys and Cu-Ti alloys, the spring critical value is definitely as high as with beryllium copper. However, the

permanent set to displacement by the spring critical value or higher is clearly high when compared to that of beryllium copper. Consequently, spring performance is not necessarily good. As shown in this example as well, the spring critical value and the permanent set to displacement by the spring critical value or higher are not related to one another and each is an independent [value]. Consequently, it is not possible to obtain high spring performance unless both properties are good. Beryllium copper does satisfy both of these properties, but it has not been possible to develop [materials] that rival [beryllium copper].

Therefore, the inventors performed various studies in order to obtain spring materials with a high spring critical value and a low permanent set to displacement by the spring critical value or higher and as a result, they obtained a spring material with both good [spring critical value and permanent set], that is, high spring performance, only when they used the method of the present invention for the alloys of the present invention.

The nonmagnetic spring materials and method for their production of the present invention will now be described. First, the reason for restricting the composition of the nonmagnetic spring material will be discussed. Manganese is an element that is necessary in order to guarantee spring strength. When the amount [of manganese] is 5% or higher, spring strength that is the same as or better than that of conventional beryllium copper is easily obtained, while if it is 35% or less, sufficient elongation is easily obtained and there will be almost no bending and there will be little permanent set when displacement by the spring critical value or higher is applied to the spring. Therefore, [the amount of

manganese] was set within this range. [A content of] 8 - 20% is preferred and 10 - 15% is most preferred. By restricting [the amount of manganese] to within this range, the permanent set to stress by the spring critical value or higher is kept very low and it is even easier to obtain a spring material [with properties that are] the same as or better than those of beryllium copper. Nickel is an element that is necessary for forming a compound with the manganese to precipitate in the alloy matrix and to improve spring strength. When the amount [of nickel] is 5% or higher, sufficient spring strength is easily obtained, while if it is 35% or less, sufficient elongation is easily obtained and there will be almost no bending and there will be little permanent set when displacement by the spring critical value or higher is applied to the spring. Therefore, [the amount of nickel] was set within this range. [A content] of 8 - 20% is preferred and 10 - 15% is most preferred. As with the manganese, by restricting [the amount of nickel] to within this range, the permanent set to displacement by the spring critical value or higher is kept even smaller and it is even easier to obtain a spring material [with properties that are] the same or better than those of beryllium copper.

The elements of group 1 elements and group 2 elements are important elements in the present invention. If there is too little of these elements, the desired properties will not be obtained because precipitation will not occur to such an extent that spring strength can be guaranteed and even though elongation will be large, the spring critical value will be low. Moreover, if the content of these elements is high, the desired spring strength will be obtained to the utmost, but elongation will be small and bending will readily occur and the

permanent set will be large when displacement exceeding the spring critical value is applied. Consequently, taking these facts into consideration, the total content of group 1 elements is 0.01 – 15%, preferably 0.02 – 13%, most preferably 0.05 – 10%, and the total content of group 2 elements is 0.001 - 5%, preferably 0.005 – 4%, most preferably 0.01 – 3%. Furthermore, the total content of elements contained in group 1 elements and group 2 elements is 0.001 – 20%.

Next, the production method will be described. First, solution-annealing treatment is performed. This treatment will homogenize the alloy components and is conducted in order to provide uniform spring strength with the aging treatment that follows. It must be performed at 700°C or higher, preferably 800°C or higher. However, taking into consideration the fact that increasing the temperature has little effect and in order to avoid the formation of coarse crystal particles, [the temperature] is 1,000°C or lower, preferably 850 – 950°C.

Next, cold drawing is performed. This cold drawing is important in the production of spring materials of the present invention, for instance, magnetic-head push springs. If cold drawing is not performed, the material will be too soft when it is molded into the spring and it will not have so-called “substance” and therefore, it will be difficult to handle when molded into a spring shape, aging treatment time will be prolonged, which is industrially [inefficient], and sufficient spring strength will not be obtained, etc. Therefore, the cold draft must be at least 10% or higher, preferably 30% or higher. However, excess cold drawing will increase the hardness of the material and the press mold will readily become

damaged during the molding of springs. Moreover, cracks will readily form in bends. Therefore, in terms of practical use, [the cold draft] is 80% or less, preferably 70% or less.

Aging treatment is performed next. This aging treatment is a heat treatment that is important for providing spring strength to the spring material of the present invention and this treatment must be performed at a temperature of 350°C or higher. However, if aging is performed at a temperature exceeding 500°C, [the material] will be over-aged and therefore, [the temperature] was set within this range. Industrially, 380 – 480°C is preferred and 430 – 470°C is most preferred.

The spring material of the present invention can be used for any part that requires elasticity. For instance, it is particularly preferred for magnetic-head push springs, connectors, and eyeglass parts.

[Examples of the Invention]

The method of production shown in Table 1 was performed for alloys having the components shown in Table 1 to make sheets with a thickness of 0.25 mm, width of 10.0 mm, and length of 100 mm. These sheets were supported at both ends at intervals of 12 mm and a weight was applied from above until a displacement of 3 mm occurred at the center. After being kept in this state for 5 seconds, the weight was removed and the permanent set at the center was determined. The results are listed in Table 1.

As is clear from these results, the alloys of the present invention have a high spring critical value and a low permanent set to displacement by the spring

critical value or greater and therefore, it can be said that they have excellent spring performance (high spring performance). Furthermore, when the spring materials of the present invention were actually mounted as magnetic-head push springs and their service life, ease of handling, and reliability were determined, it was confirmed that they were the same as or better than beryllium copper alloy.

[Results of the Invention]

The spring materials of the present invention that were produced by the above-mentioned production method have excellent spring properties and are therefore ideal as spring materials for electronic components, magnetic parts, etc.

Table 1.

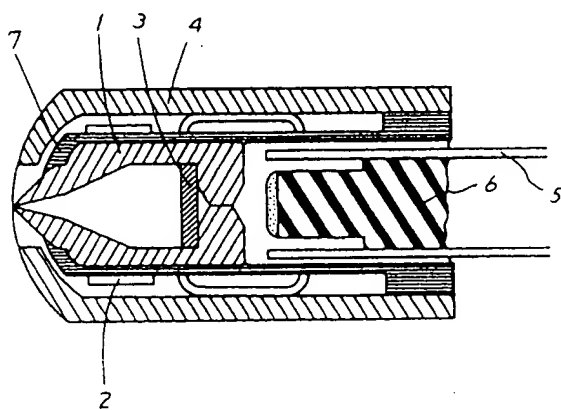
	Components				Production method				Properties	
	Cu	Mn	Ni	Group 1 elements	Group 2 elements	Solution annealing	Cold drawing	Aging	Spring critical value	Permanent set to displacement by spring critical value or higher
Sample 1	bal.	1.7	1.7	Cr 2.0	S 0.01	900	10	450 °C x 3 h	120	1.3
2	"	"	"	"	"	"	50	"	130	1.1
3	"	"	"	"	"	"	70	"	135	0.9
4	"	"	"	Ho 1.0	In 0.5	"	30	"	110	1.1
5	"	"	"	"	"	"	50	"	120	1.2
6	"	"	"	Co 1.0, Ti 1.0	--	1000	"	450 °C x 3.5 h	"	1.5
7	"	"	"	"	"	"	70	450 °C x 3 h	130	"
8	"	14	14	Nb 0.5	S 0.05	900	30	"	110	1.0
9	"	"	"	"	"	"	50	"	115	"
10	"	"	"	"	"	"	70	"	120	1.1
11	"	"	"	Co 1.0, Ti 0.5	In 0.2	"	10	450 °C x 4 h	110	0.9
12	"	"	"	"	"	"	30	"	120	"
13	"	"	"	"	"	"	50	"	125	1.0
14	"	"	"	Zr 0.4	Y 0.01	950	30	450 °C x 3 h	115	1.2
15	"	"	"	"	"	"	50	"	125	"
16	"	"	"	Cr 2.0, Zr 0.2	Te .01, In 0.1	1000	30	450 °C x 2.5 h	120	1.1
17	"	"	"	"	"	"	50	"	125	1.2
18	"	"	"	"	"	"	70	"	130	1.0
19	"	17	17	Cr 2.0	S 0.01	900	50	300 °C x 4 h	70	2.0
20	"	"	"	"	"	"	"	350 °C x 4 h	70	2.1
21	"	"	"	"	"	"	"	400 °C x 4 h	75	1.8
22	"	"	"	"	"	650	"	450 °C x 4 h	80	2.3
23	"	"	"	"	"	600	"	"	"	2.3
24	"	35	35	Mo 1.0	In 0.5	900	30	450 °C x 3 h	160	--

25	"	"	"	"	"	"	"	"	"	400 °C x 3 h	120	--	--
26	"	"	"	"	"	"	"	"	"	350 °C x 3 h	100	2.4	
27	"	"	"	"	Nb 1.0	S 0.1	"	"	10	450 °C x 3 h	160	--	
28	"	"	"	"	"	"	"	"	30	400 °C x 3 h	100	--	
29	"	--	--	"	Be 2.0, Co 0.26	(Commercial Be-Cu alloy)	--	--	--	--	"	1.0	

4. Brief Description of the Invention

Figure 1 is a cross section showing an example of the magnetic head. (1) in the figure is the core, (2) is the magnetic-head push spring, (3) is the coil, (4) is the shield case, (5) is the terminal, (6) is the resin, and (7) is the core holder.

Figure 1.



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⑭ 発明の名称 非磁性バネ材及びその製造方法

⑯ 特 願 昭61-41942

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明 細 書

1. 発明の名称

非磁性バネ材及びその製造方法

2. 特許請求の範囲

1. 重量パーセントでマンガン 5~35%、ニッケル 5~35%に、下記第1元素群及び/又は第2元素群に含まれるいずれかの元素を一種又は二種以上合計で 0.001~20%含有し、残部が実質的に銅でなる高バネ性を有する非磁性バネ材。

(記)

第1元素群 アルミニウム、ケイ素、チタン、バナジウム、クロム、鉄、コバルト、ゲルマニウム、ヒ素、亜鉛、スズ、ジルコニウム、ニオブ、モリブデン、ハフニウム、タンタル、タングステン

なお第1元素群の元素の合計含有量は 0.01~15%の範囲とする。

第2元素群 炭素、窒素、マグネシウム、ベリ

リウム、リン、イオウ、カルシウム、ガリウム、セレン、イットリウム、希土類元素、銀、インジウム、テルル、鉛

なお第2元素群の合計含有量は 0.001~5%の範囲とする。

2. バネ限界値が $100\text{Kg}/\text{mm}^2$ 以上でかつバネ限界値以上の変位に対する永久歪が小さいことを特徴とする特許請求の範囲第1項に記載の非磁性バネ材。

3. バネ材は磁気ヘッド用であることを特徴とする特許請求の範囲第1項に記載の非磁性バネ材。

4. 重量パーセントでマンガン 5~35%、ニッケル 5~35%に、第1元素群及び/又は第2元素群に含まれるいずれかの元素を一種又は二種以上合計で 0.001~20%含有し、残部が実質的に銅でなる合金を、溶体化処理後冷間加工を施し、更に時効処理を施して成ることを特徴とする高バネ性を有する非磁性バネ材の製造方法。

第1元素群 アルミニウム、ケイ素、チタン、
バナジウム、クロム、鉄、コバル
ト、ゲルマニウム、ヒ素、亜鉛、
スズ、ジルコニウム、ニオブ、モ
リブデン、ハフニウム、タンタル、
タングステン

なお第1元素群の元素の合計含有量は 0.01
～15%の範囲とする。

第2元素群 炭素、窒素、マグネシウム、ベリ
リウム、リン、イオウ、カルシウ
ム、マンガン、セレン、イットリ
ウム、希土類元素、銀、インジウ
ム、テルル、鉛

なお第2元素群の元素の合計含有量は
0.001～5%範囲とする。

5. 溶体化処理は 700℃～1000℃でなされるこ
とを特徴とする特許請求の範囲第4項に記載の
非磁性バネ材の製造方法。

6. 冷間加工は、10%以上の加工率でなされる
ことを特徴とする特許請求の範囲第4項に記載

の非磁性バネ材の製造方法。

7. 時効処理は 350℃～500℃でなされること
を特徴とする特許請求の範囲第4項に記載の非
磁性バネ材の製造方法。

3. 発明の詳細な説明

(発明の技術分野)

この発明は非磁性でかつ優れたバネ性をもつ
バネ材およびその製造方法に関する。

(発明の技術的背景およびその問題点)

磁気記録関連機器をはじめとし、磁場の存在
下ではしばしば非磁性でかつ優れたバネ性を有
する高強度バネが要求される。たとえば磁気ヘ
ッドの製造においては磁気ヘッドのケーシング
工程で第1図に示したようにコア(1)、巻線コ
イル(3)、端子(5)、樹脂部(6)、コアホルダ
ー(7)等からなる磁気ヘッドをシールドケース
(4)に固定し、かつ寸法精度を維持するために
磁気ヘッド押えバネ(2)が使用されている。

この磁気ヘッド押えバネには、これまでリン
青銅やベリリウム銅が使用されているが最近

磁気ヘッドの高性能化が進み製造技術が一段と
困難になってきており、この磁気ヘッド押えバ
ネにもより寸法精度を良くすることを目的にバ
ネ性の高いものが要求されてきている。この観
点からベリリウム銅はよい材料といえるがその
製造工程において人体に有害なベリリウムの蒸
気やベリリウムの酸化物などを発生すること、
及びその製造工程が煩雑であることから改善が
望まれている。

またベリリウム銅と同等の高いバネ性を有す
る合金として、最近Ni-Si-Cu系合金やTi-Cu
系合金が開発されているが、この合金も十分で
はなかった。

(本発明の目的)

本発明は上記に鑑みてなされたもので、ベリ
リウム銅と同等あるいはそれ以上のバネ性を有
する非磁性のバネ材およびその製造方法を提供
することを目的としたものである。

(発明の概要)

本願発明者らは重量パーセントでマンガン 5

～35%、ニッケル 5～35%に、第1元素群及び
／又は第2元素群に含まれるいずれかの元素を
一種又は二種以上合計で 0.001～20%含有し、
残部が実質的に銅でなる合金に溶体化処理後冷
間加工を施し、更に時効処理を施す方法を適用
することによりベリリウム銅と同等の高バネ性
が得られることを初めて見出した。

第1元素群 アルミニウム、ケイ素、チタン、
バナジウム、クロム、鉄、コバル
ト、ゲルマニウム、ヒ素、亜鉛、
スズ、ジルコニウム、ニオブ、モ
リブデン、ハフニウム、タンタル、
タングステン

なお第1元素群の元素の合計含有量は 0.01
～15%の範囲とする。

第2元素群 炭素、窒素、マグネシウム、ベリ
リウム、リン、イオウ、カルシウ
ム、ガリウム、セレン、イットリ
ウム、希土類元素、銀、インジウ
ム、テルル、鉛

なお第2元素群の元素の合計含有量は 0.001 ~ 5% 範囲とする。

即ちバネ性は従来からバネ限界値（又は引張り強度）のみで判断されて来たが、本願発明者らが初めてバネ性にはバネ限界値だけでなく、バネ限界値以上の応力に対する永久歪が重要であり、これらの双方（バネ限界値とバネ限界値以上の変位に対する永久歪）の特性が満足されて初めて高バネ性が得られることを見出した。例えば、Cu-Ni-Sn系合金、Cu-Ti合金について検討して見ると、バネ限界値は確かにベリリウム銅と同等に高い。しかしバネ限界値以上の変位に対する永久歪はベリリウム銅に比べてはるかに大きい。したがってバネ性は必ずしも良くないのである。この例でも示される様にバネ限界値と、バネ限界値以上の変位に対する永久歪とは互に関連がなく、それぞれ独立なのである。したがって、意図して双方の特性が良好なものを得ない限り高バネ性のものを得たということにならない。この双方の特性を満足するの

としては、ベリリウム銅があるが、これに匹敵するものがなかなか開発できなかったのである。

そこで本願発明者らはバネ限界値が高く、かつバネ限界値以上の変位に対する永久歪が小さいバネ材を得る為種々研究実験した結果、本願発明の合金に対して本願発明の方法を適用したとき初めて、双方の特性の良いもの即ち高バネ性のバネ材が得られたのである。

ここで本願発明に係る非磁性バネ材及びその製造方法について説明する。まず非磁性バネ材の組成の限定理由について述べる。マンガンはバネ強さを確保する為に必要な元素で、その量が5%以上であると、従来のベリリウム銅と同等以上のバネ強さが得られやすく、又35%以下であると十分な伸びが得られやすくバネ限界値を超えた変位をバネに加えた場合折れにくく、かつ永久歪が小さいことからこの範囲とした。なお望ましくは 8~20%、更に望ましくは10~15%が良い。この様に範囲を限定することによ

り、バネ限界値以上の応力に対する永久歪は著しく小さくなり、ベリリウム銅同等以上のバネ材が一層得られやすくなる。ニッケルは、マンガンと化合物を形成して合金素地中に析出し、バネ強さを向上させるのに必要な元素でその量が5%以上で充分なバネ強さが得られやすく、又35%以下になると充分な伸びが得られやすく、バネ限界値を超えた応力をバネに加えた場合折れにくく、かつ永久歪が小さいことからこの範囲とした。なお望ましくは 8~20%、更に望ましくは10~15%が良い。この様に範囲を限定することによりマンガン同様バネ限界値以上の変位に対する永久歪は更に小さくなり、ベリリウム銅同等以上のバネ材が一層得られやすくなる。

第1元素群及び第2元素群の元素は本願発明において重要な元素である。これらの元素が少なすぎるとバネ強さを確保できるだけの析出が出せず、伸びは大きいもののバネ限界値が低く所望の特性が得られない。またこれら元素の多

量の含有は所望のバネ強さは十分得られるものの、伸びが小さくなりバネ限界値を超えた変位を加えた場合折損し易くなるとともに永久歪が大きくなる。したがって、これらの事を考慮して第1元素群の元素の合計の含有量は 0.01 ~ 15% 好ましくは 0.02 ~ 13%、更に好ましくは 0.05 ~ 10%、第2元素群の元素の合計の含有量は 0.001 ~ 5%、好ましくは 0.005 ~ 4% 更に好ましくは 0.01 ~ 3% が良い。なお、第1元素群及び第2元素群に含まれる元素の合計含有量は 0.001 ~ 20% が良い。

次に製造方法について説明する。まず溶体化処理であるが、この処理は合金成分を均質化し、またその後の時効処理で均質なバネ強さを付与するためのもので少なくとも 700℃ 以上は必要で望ましくは 800℃ 以上が良い。しかし温度を高くしてもその効果は小さくなり、また結晶粒の粗大化をまねくことなどの点から 1000℃ 以下としたが望ましくは 850 ~ 950℃ が良い。次に冷間加工であるが、この冷間加工は本発明

に係るバネ材、例えば磁気ヘッド押えバネの製造にとって重要であり、冷間加工を施さないとバネ形状に成形する際素材がやわらかすぎて、いわゆる腰のない状態であるため、バネ形状への成形時に取扱いが困難であること、また時効処理時間が長くなり工業的でないこと、十分なバネ強さが得られないことなどにより、その冷間加工率は少なくとも10%以上が必要で、望ましくは30%以上が良いが、過度の冷間加工は素材の硬さを上げバネ成形時にプレス金型をいためやすくすること、曲げ加工部分に割れが入りやすくなることから実用上80%以下、望ましくは70%以下が良い。

次に時効処理であるが、この時効処理は本発明に係るバネ材のバネ強さを与えるために重要な熱処理で350℃以上の温度で処理することが必要であるが、500℃を超えた温度での時効処理では過時効となることからこの範囲としたが、工業的に望ましくは380℃～480℃が良く更に望ましくは430℃～470℃が良い。

れ以上と確認できた。

(発明の効果)

前記製法により製造された本発明のバネ材は極めて優れたバネ性を有している為、電子部品、磁気部品などのバネ材として好適である。

(以下余白)

ところで本願発明のバネ材としては、弾性を求められる部品であれば何でも良く、例えば磁気ヘッド押えバネ、コネクター、眼鏡部品が特に好ましい。

(発明の実施例)

第1表に示す成分を有する合金について第1表に示す製造方法を施して板厚0.25mm、幅10.0mm、板長100mmの板を作成した。この板を間隔12mmで両端を支え、上方から中心部の変位が3mmになるまで荷重をかける。この状態で5秒保ったのち荷重をとぎ、そのときの中央部に生じた永久歪を測定した。その結果を第1表に記載した。

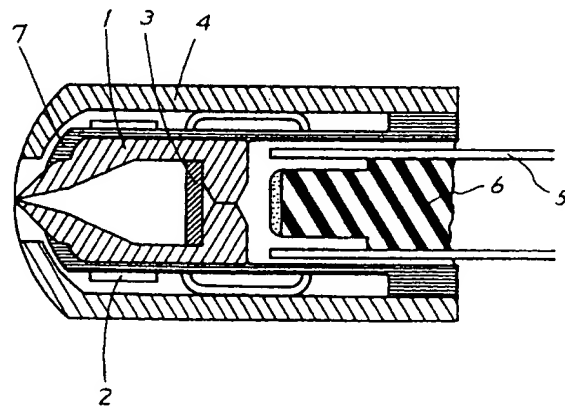
この結果よりわかる様に本発明の合金はバネ限界値が高く、かつバネ限界値上のある変位に対する永久歪が小さい為、極めて優れたバネ性(高バネ性)を有すると言える。更に本発明のバネ性を実際に磁気ヘッド押えバネとして実装して、その寿命、扱いやすさ及び信頼性を測定したところ、ベリリウム-銅合金と同等又はそ

第 1 表

		成 分					製 法			特 性	
		Cu	Mn	Ni	第1元素群	第2元素群	溶体化処理	冷間加工	時 効	バネ降伏強	バネ降伏値以上の変位に対する永久変
試験例	1	bal.	1.7	1.7	Cr 2.0	S 0.01	900	10	450℃× 3h	120	1.3
"	2	"	"	"	"	"	"	50	"	130	1.1
"	3	"	"	"	"	"	"	70	"	135	0.9
"	4	"	"	"	Mo 1.0	In 0.5	"	30	"	110	1.1
"	5	"	"	"	"	"	"	50	"	120	1.2
"	6	"	"	"	Co 1.0, Ti 1.0	—	1000	"	450℃× 3.5h	"	1.5
"	7	"	"	"	"	"	"	70	450℃× 3h	130	"
"	8	"	1.4	1.4	Nb 0.5	S 0.05	900	30	"	110	1.0
"	9	"	"	"	"	"	"	50	"	115	"
"	10	"	"	"	"	"	"	70	"	120	1.1
"	11	"	"	"	Co 1.0, Ti 0.5	In 0.2	"	10	450℃× 4h	110	0.9
"	12	"	"	"	"	"	"	30	"	120	"
"	13	"	"	"	"	"	"	50	"	125	1.0
"	14	"	"	"	Zr 0.5	Y 0.01	950	30	450℃× 3h	115	1.2
"	15	"	"	"	"	"	"	50	"	125	"
"	16	"	"	"	Cr 2.0, Zr 0.2	Te 0.01, In 0.1	1000	30	450℃× 2.5h	120	1.1
"	17	"	"	"	"	"	"	50	"	125	1.2
"	18	"	"	"	"	"	"	70	"	130	1.0
"	19	"	1.7	1.7	Cr 2.0	S 0.01	900	50	300℃× 4h	70	2.0
"	20	"	"	"	"	"	"	"	350℃× 4h	"	2.1
"	21	"	"	"	"	"	"	"	400℃× 4h	75	1.8
"	22	"	"	"	"	"	650	"	450℃× 4h	80	2.3
"	23	"	"	"	"	"	600	"	"	"	2.3
"	24	"	3.5	3.5	Mo 1.0	In 0.5	900	30	450℃× 3h	160	—
"	25	"	"	"	"	"	"	"	400℃× 3h	120	—
"	26	"	"	"	"	"	"	"	350℃× 3h	100	2.4
"	27	"	"	"	Nb 1.0	S 0.1	"	10	450℃× 3h	160	—
"	28	"	"	"	"	"	"	30	400℃× 3h	100	—
"	29	"	—	—	Be 2.0, Co 0.28 (市販のBe-Cu 合金)	—	—	—	—	"	1.0

4. 図面の簡単な説明

第1図は磁気ヘッドの一例を示す断面図で、
 図中(1)はコア、(2)は磁気ヘッド押えバネ、
 (3)は巻線コイル、(4)はシールドケース、
 (5)は端子、(6)は樹脂、(7)はコアホルダー
 である。



第 1 図

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